

# Rehabilitation Guidelines for Posterior Cruciate Ligament Reconstruction

The knee has three joints--the patellofemoral joint (knee cap), the tibiofemoral joint and the tibiofibular joint. Joints are named for the two bones that articulate with each other. Most people think of the tibiofemoral joint when thinking of the knee. This is the joint that is primarily responsible for flexing (bending) and extending (straightening) of the knee. A small amount of rotation occurs at this joint as well. Ligaments are bundles of connective tissue that attach from bone to bone. There are four main ligaments that stabilize the knee. The collateral ligaments (medial and lateral) are on the inside and outside of the knee and provide side to side stability for the knee. The cruciate ligaments (anterior and posterior) are two large ligaments that cross in the middle of the knee and provide rotational stability and stability front to back. The posterior cruciate ligament is a large, broad ligament that attaches from the back of the tibia and travels forward as it moves up to attach to the femur (Figures 1 and 2). Its primary function is to resist posterior translation of the tibia on the femur, especially in flexion. It is also a secondary stabilizer for rotation and varus stability.

Injuries of the posterior cruciate ligament (PCL) occur less frequently than those of the anterior cruciate ligament (ACL). The PCL is taught

(tight) when the knee is in flexion, thus most PCL injuries occur in flexion. The most common cause of PCL tears (Figure 3) are sports injuries (37%) and trauma (56%).<sup>1</sup> In sports, the most common mechanism is falling on a flexed knee. In auto accidents, the most common mechanism is hitting the upper shin against the dashboard with the knee flexed during an accident (dashboard injury). Immediately after the injury it is common to have swelling in the knee, general knee pain and a loss of motion.<sup>1</sup> It is often difficult to predict the long term outcome of a PCL injury.<sup>1</sup> Some patients show significant symptoms and subsequent articular deterioration after a PCL injury, while others are essentially asymptomatic, maintaining normal function.<sup>2</sup> Evidence from randomized controlled trials to determine a single treatment of PCL injuries is lacking. Observational studies suggest that isolated PCL injuries may be treated conservatively, with good prognosis. Shelbourne treated 22 isolated grade 1 and grade 2 PCL injuries with extension bracing for six weeks.<sup>3</sup> In Shelbourne's study 19 of the 22 patients went on to show healing by MRI, and demonstrated stability.<sup>3</sup> Bracing is primarily effective when it can be started within one week of the injury.

Surgical reconstruction is indicated in patients with PCL injuries that are



**Figure 1** Posterior (back) view of the knee with the PCL shaded in red

combined with other ligament injuries in the knee (combination injuries or multi-ligamentous injuries), isolated grade 3 injuries or PCL injuries with chronic instability. Patients with chronic instability rarely suffer complete giving way episodes. More often it is a general sense of instability with pain in the front of their knee, especially with running or stair climbing.<sup>1</sup> Posterior laxity can be assessed with a posterior drawer test, the dial test or a KT1000 test, although laxity is not directly correlated to instability. Surgical reconstruction is done by replacing the torn PCL with a graft. This graft can be a single strand/

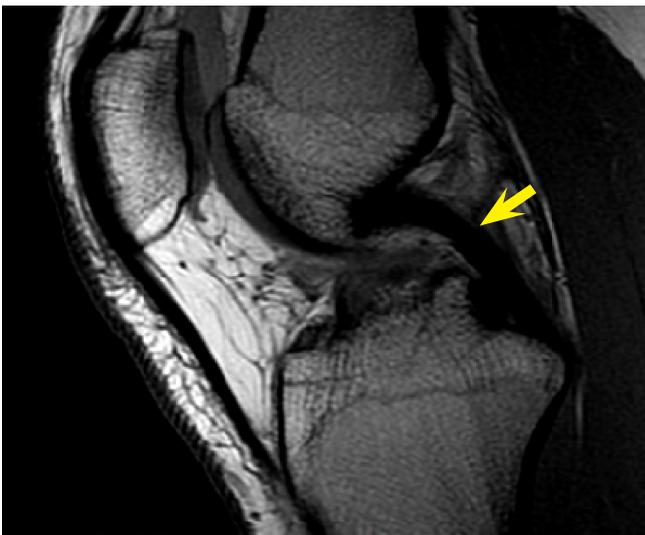
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bundle of tissue or two strands (double bundle). Grafts can be taken from areas of your own body (autograft), such as the patellar tendon, or from cadavers (allograft). To date there have not been significant differences in outcome studies comparing the various graft choices.<sup>1</sup> The grafts are placed and anchored in tunnels drilled in the femur and tibia.

The rehabilitation process begins the first week after surgery. During the first four weeks the weight bearing and range of

motion is limited to protect the healing of the graft. Hamstring exercises are also avoided because the hamstring pulls the tibia posteriorly (backward), which would cause stress to the healing graft. In phase 2 patients will begin to work more aggressively on strength and range of motion, usually discontinuing all use of the brace by six weeks. Prior to returning to sports, patients must regain strength, movement control, proprioception and force control. This often involves several months of progressive rehabilitation

exercises. The rehabilitation guidelines below are presented in a criterion based progression. Specific time frames, restrictions and precautions are given to protect healing tissues and the surgical repair/reconstruction. General time frames are also given for reference to the average, but individual patients will progress at different rates depending on their age, associated injuries, pre-injury health status, rehab compliance and injury severity.



**Figure 2** Saggital PD MRI demonstrating a normal PCL



**Figure 3** Saggital T1 MRI demonstrating a torn PCL

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### PHASE I (Surgery to 4 weeks after surgery)

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointments: 1-2 weeks and 4-6 weeks after surgery</li> <li>• Rehabilitation appointments begin 1-3 days after surgery, meet 2 times per week</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Protection of the post-surgical knee</li> <li>• Restore normal knee extension</li> <li>• Eliminate effusion</li> <li>• Restore leg control</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Weight bearing as tolerated using pain and gait as guides</li> <li>• Must wear the brace for all weight bearing activities Progress from locked to unlocked when patient has good quadriceps control</li> <li>• Use axillary crutches for normal gait</li> <li>• No open chain hamstring strengthening or isolated hamstring exercises. No hamstring stretching. No bike</li> <li>• Follow range of motion guidelines</li> </ul>
<b>Range of Motion Exercises</b>	<ul style="list-style-type: none"> <li>• Weeks 0-4: range of motion = full extension to 90° flexion</li> <li>• Extension: Knee extension on a bolster, avoid prone hangs secondary to hamstring guarding</li> <li>• Flexion: use gravity or assistance to minimize hamstring activity, such as supine wall slides or seated knee flexion</li> </ul>
<b>Suggested Therapeutic Exercise</b>	<ul style="list-style-type: none"> <li>• Quadriceps sets</li> <li>• Open chain knee extension against gravity</li> <li>• Straight leg raises</li> <li>• Leg lifts in standing with brace on for balance and hip strength – avoid hip extension 2° to hamstring restrictions</li> </ul>
<b>Cardiovascular Exercise</b>	<ul style="list-style-type: none"> <li>• Upper body circuit training or upper body ergometer</li> </ul>
<b>Progression Criteria</b>	<ul style="list-style-type: none"> <li>• Patient may progress to Phase II if they have met the above stated goals and have</li> <li>• Painfree gait using brace without crutches,</li> <li>• No effusion</li> <li>• Knee flexion to 90°</li> </ul>

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### PHASE II (begin after meeting Phase I criteria, usually at 5 weeks after surgery)

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment: 8-12 weeks after surgery</li> <li>• Rehabilitation appointments are 1-2 times per week</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Single leg stand control</li> <li>• Normalize gait</li> <li>• Good control and no pain with functional movements, including step up/down, squat, partial lunge (keeping the knee in less than 60° of knee flexion)</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Discontinue brace over weeks 4-6 as the patient gains leg control and balance</li> <li>• No open chain hamstring strengthening or isolated hamstring exercises. No hamstring stretching. No bike</li> <li>• Follow range of motion guidelines – no forced hyperflexion</li> </ul>
<b>Range of Motion Exercises</b>	<ul style="list-style-type: none"> <li>• Weeks 5-6: range of motion = full extension to 120° flexion <u>Gradually</u> attain full flexion, avoiding forced flexion</li> <li>• Extension: Knee extension on a bolster, avoid prone hangs secondary to hamstring guarding</li> <li>• Flexion: use gravity or assistance to minimize hamstring activity, such as supine wall slides or seated knee flexion</li> </ul>
<b>Suggested Therapeutic Exercise</b>	<ul style="list-style-type: none"> <li>• Quadriceps strengthening – closed chain exercises short of 70° of knee flexion</li> <li>• Non-impact balance and proprioceptive drills</li> <li>• Gait drills</li> <li>• Hip and core strengthening</li> <li>• Stretching for patient specific muscle imbalances</li> </ul>
<b>Cardiovascular Exercise</b>	<ul style="list-style-type: none"> <li>• Upper body circuit training or upper body ergometer</li> </ul>
<b>Progression Criteria</b>	<ul style="list-style-type: none"> <li>• Patient may progress to Phase III if they have met the above stated goals and have</li> <li>• Normal gait on all surfaces</li> <li>• Ability to carry out functional movements without unloading affected leg and without pain, while demonstrating good control</li> <li>• Single-leg balance greater than 15 seconds</li> <li>• Full range of motion.</li> </ul>

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### PHASE III (begin after meeting Phase II criteria, usually about 12-16 weeks)

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment: 3 and 4 months after surgery</li> <li>• Rehabilitation appointments are 1-2 times per week</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Good control and no pain with functional movements, including step up/down, squat and lunge</li> <li>• Good control and no pain with light agility and low-impact multi-plane drills</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• No open chain hamstring strengthening or isolated hamstring exercises.</li> </ul>
<b>Suggested Therapeutic Exercise</b>	<ul style="list-style-type: none"> <li>• Quadriceps strengthening – closed chain (progressing to multi-plane) and open chain exercises</li> <li>• Non-impact balance and proprioceptive drills</li> <li>• Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot</li> <li>• Movement control exercise beginning with low velocity, single-plane activities and progressing to higher velocity, multi-plane activities</li> <li>• Hip and core strengthening</li> <li>• Stretching for patient specific muscle imbalances</li> </ul>
<b>Cardiovascular Exercise</b>	<ul style="list-style-type: none"> <li>• Upper body circuit training or upper body ergometer</li> </ul>
<b>Progression Criteria</b>	<ul style="list-style-type: none"> <li>• Patient may progress to Phase IV if they have met the above stated goals and have</li> <li>• Normal gait on all surfaces</li> <li>• Ability to carry out multi-plane functional movements with out unloading affected leg or pain, while demonstrating good control</li> <li>• Ability to land from a sagittal, frontal and transverse plane leap with good control and balance</li> </ul>

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### PHASE IV (begin after meeting Phase III criteria, usually about 24 weeks)

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment: 6, 9 and 12 months after surgery</li> <li>• Rehabilitation appointments are 1 time per every 2-4 weeks</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Good dynamic neuromuscular control and no pain with sport and work-specific movements, including impact</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Post-activity soreness should resolve within 24 hours</li> <li>• Avoid post-activity swelling</li> </ul>
<b>Suggested Therapeutic Exercise</b>	<ul style="list-style-type: none"> <li>• Sport/work specific balance and proprioceptive drills</li> <li>• Progress impact control exercises to reactive strengthening and plyometrics. Incorporate running program as appropriate</li> <li>• Continue quadriceps strengthening</li> <li>• Hip and core strengthening</li> <li>• Stretching for patient specific muscle imbalances</li> </ul>
<b>Cardiovascular Exercise</b>	<ul style="list-style-type: none"> <li>• Replicate sport or work specific energy demands</li> </ul>
<b>Return To Sport/Work Criteria</b>	<ul style="list-style-type: none"> <li>• Dynamic neuromuscular control with multi-plane activities, without instability, pain or swelling</li> </ul>

These rehabilitation guidelines were developed collaboratively by Marc Sherry, PT, LAT, CSCS (msherry@uwhealth.org) and the UW Sports Medicine physician group.

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### References

1. Petrigliano FA, McAllister DR. Isolated posterior cruciate ligament injuries of the knee. *Sports Med Arthrosc.* Dec 2006;14(4):206-212.
2. Peccin MS, Almeida GJ, Amaro J, Cohen M, Soares BG, Atallah AN. Interventions for treating posterior cruciate ligament injuries of the knee in adults. *Cochrane Database Syst Rev.* 2005(2):CD002939.
3. Shelbourne KD, Jennings RW, Vahey TN. Magnetic resonance imaging of posterior cruciate ligament injuries: assessment of healing. *Am J Knee Surg.* Fall 1999;12(4):209-213.
4. Chhabra A, Kline AJ, Harner CD. Single-bundle versus double-bundle posterior cruciate ligament reconstruction: scientific rationale and surgical technique. *Instr Course Lect.* 2006;55:497-507.
5. Christel P. Basic principles for surgical reconstruction of the PCL in chronic posterior knee instability. *Knee Surg Sports Traumatol Arthrosc.* Sep 2003;11(5):289-296.
6. Margheritini F, Rihn J, Musahl V, Mariani PP, Harner C. Posterior cruciate ligament injuries in the athlete: an anatomical, biomechanical and clinical review. *Sports Med.* 2002;32(6):393-408.

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